What is claimed is:

1	1. A recombinant DNA comprising said DNA selected from the group consisting of:
2	a) a recombinant DNA that encodes a protein having an amino acid
3	sequence as shown in SEQ. ID. NO. 3;
4	b) a recombinant DNA that encodes a protein having an amino acid
5	sequence as shown in SEQ. ID. NO. 5;
6	c) a recombinant DNA that encodes a protein having an amino acid
7	sequence as shown in SEQ. ID. NO. 7;
B 8 9 10 F 11 F 11	d) a recombinant DNA that encodes a protein having an amino acid
Q 9	sequence as shown in SEQ. ID. NO. 9;
년 일10	e) a recombinant DNA that encodes a protein having an amino acid
11 L	sequence as shown in SEQ. ID. NO. 11; and
12	f)any portion of said DNA above that encodes a protein that elicits an
12 113	immune response against E. canis.
1	2. The recombinant DNA of claim 1 wherein said DNA encodes at least one
2	immunogenic epitope.
1	3. A recombinant protein comprising said protein selected from the group consisting of
2	a) a protein having an amino acid sequence as shown in SEQ. ID. NO. 3;
3	b) a protein having an amino acid sequence as shown in SEQ. ID. NO. 5;
4	c) a protein having an amino acid sequence as shown in SEQ. ID. NO. 7;
5	d) a protein having an amino acid sequence as shown in SEQ. ID. NO. 9;
6	e) a protein having an amino acid sequence as shown in SEQ. ID. NO. 11; and

	8	against E. canis.
	1 2	4. The recombinant protein of claim 3 wherein said protein includes at least one immunogenic epitope.
	1	5. A vaccine wherein said vaccine protects dogs against E. canis infection.
	1	6. A vaccine comprising:
	2	a) a vector capable of expressing a recombinant DNA inserted into said
	3	vector such that a recombinant protein is expressed when said
TUUDA	4	vector is provided in an appropriate host; and
	5	b) the recombinant DNA inserted into said vector wherein said DNA is
	6	selected from the group consisting of:
	7	i) a recombinant DNA that encodes a protein having an amino acid
	8	sequence as shown in SEQ. ID. NO. 3;
	9	ii)a recombinant DNA that encodes a protein having an amino acid
	10	sequence as shown in SEQ. ID. NO. 5;
	11	iii)a recombinant DNA that encodes a protein having an amino acid
	12	sequence as shown in SEQ. ID. NO. 7;
	13	iv)a recombinant DNA that encodes a protein having an amino acid
	14	sequence as shown in SEQ. ID. NO. 9;
	15	v)a recombinant DNA that encodes a protein having an amino acid
	16	sequence as shown in SEQ. ID. NO. 11; and
	17	vi)any portion of said DNA above that encodes a protein fragment
	18	that is greater than 25 amino acids.
	1	7. The vaccine of claim 6, wherein said DNA further comprises DNA that encodes CpG
	2	motifs.

	1	8. The	vaccine of claim 6 wherein said DNA further comprises a promoter selected from
	2		the group consisting of:
	3		a) a cytomegalovirus (CMV) immediate early promoter;
	4		b) a human tissue plasminogen activator gene (t-PA); and
	5		c) promoter/enhancer region of a human elongation factor alpha (EF-1 α).
	1	9. The	vaccine of claim 6, wherein said vector is selected from the group consisting of:
ĥà	2		a) pcDNA3;
	3		b) pC1;
THE PARTY	4		c) VR1012; and
	5		d) VR1020.
jus.	1	10. Th	e vaccine of claim 6 wherein said vaccine is administered into said host by a
	2		method selected from the group consisting of:
TŲ Č			
223	3		a) intramuscular injection;
	4		b) intravenous injection; and
	5		c) gene gun injection.
	1	11. Th	e vaccine of claim 10, wherein said host is a dog.
	1	12. Th	e vaccine of claim 5 comprising:
	2		a) a recombinant protein that is selected from the group consisting of:
	3		i) a protein having an amino acid sequence as shown in SEQ. ID. NO.
	4		3;
	5		ii) a protein having an amino acid sequence as shown in SEQ. ID.
	6		NO. 5;

7	iii) a protein having an amino acid sequence as shown in SEQ. ID.
8	NO. 7;
9	iv) a protein having an amino acid sequence as shown in SEQ. ID.
10	NO. 9;
11	v) a protein having an amino acid sequence as shown in SEQ. ID.
12	NO. 11; and
13	vi) any portion of any of the above proteins that elicits an immune
14	response against E. canis.
	13. The vaccine of claim 12, wherein said vaccine further comprises adjuvants selected
□ 2 -	from the group consisting of:
	a) aluminum hydroxide;
4	b) QuilA; and
5 D	c) Montamide.
	14. The vaccine of claim 12 further comprising a cytokine operatively associated with
2	said recombinant protein.
1	15. The vaccine of claim 14 wherein said cytokine is selected from the group consisting
2	of:
3	a) interleukin-1β (IL-1β);
4	b) granulocyte-macrophage colony stimulating factor (GM-CSF);
5	c) gamma interferon (γ-IFN);
6	d) amino acids VQGEESNDK from the IL-Iβ protein; and
7	e) any portion of any of the cytokines above that elicits an improved
8	immunogenic response against E. canis.

1	16. The vaccine of claim 12 wherein said vaccine is administered into a host by a method
2	selected from the group consisting of:
3	a) intramuscular injection; and
4	b) subcutaneous injection.
1	17. The vaccine of claim 16 wherein said host is a dog.
1	18. The vaccine of claim 5 comprising a recombinant protein that includes a T cell epitope
2	wherein said T cell epitope comprises an amino acid peptide fragment of a protein
3	selected from the group consisting of:
	a) a protein having an amino acid sequence as shown in SEQ. ID. NO. 3;
- 	b) a protein having an amino acid sequence as shown in SEQ. ID. NO. 5;
£ : 6	c) a protein having an amino acid sequence as shown in SEQ. ID. NO. 7;
	d) a protein having an amino acid sequence as shown in SEQ. ID. NO. 9;
8	e) a protein having an amino acid sequence as shown in SEQ. ID. NO. 11; and
10 11	f) any portion of any of the above proteins that elicits an immune response against E. canis.
1 2	19. The vaccine of claim 18 wherein said amino acid peptide fragment comprises nine to twenty amino acids.
1	20. The vaccine of claim 18 further comprising a recombinant DNA encoding a protein
2	which is capable of being internalized into eukaryotic cells, including cells of the
3	immune system.
1	21. The vaccine of claim 20 wherein said protein capable of being internalized into
2	eukaryotic cells comprises a toxin selected from the group consisting of:
3	a) a recombinant adenylate cyclase of Bordetella bronchiseptica; and

4	b) a recombinant exotoxin A (PE) of Pseudomonas aeruginosa.
1	22. The vaccine of claim 18 wherein said vaccine is administered into a host by a method
2	selected from the group consisting of:
3	a) intramuscular injection; and
4	b) subcutaneous injection.
1	23. The vaccine of claim 22 wherein said host is a dog.
1	24. A method of identifying a T cell epitope against E. canis comprising:
2	a) synthesizing overlapping peptide fragments over an entire length of a
₫ 3	protein wherein said protein is selected from the group consisting
2 2 3 4 5	of:
5	i) a protein having an amino acid sequence as shown in SEQ. ID. NO.
F 6 7 7 8 5 8	3;
7	ii) a protein having an amino acid sequence as shown in SEQ. ID.
9 8	NO. 5;
9	iii) a protein having an amino acid sequence as shown in SEQ. ID.
10	NO. 7;
11	iv) a protein having an amino acid sequence as shown in SEQ. ID.
12	NO. 9;
13	v) a protein having an amino acid sequence as shown in SEQ. ID.
14	NO. 11; and
15	vi) any portion of any of the proteins above that elicits an immune
16	response against E. canis;
17	b) testing said peptide fragment to determine if said peptide fragment elicits
18	an immune response in a host animal; and

20	fragment elicits an immune response.
1 2	25. The method of claim 24 wherein said peptide fragment comprises nine to twenty amino acids.
1	26. A method of creating a vaccine against Ehrlichia canis comprising:
2	a) selecting a vector capable of expressing a recombinant DNA inserted into said vector; and
105 6 7 8	b) inserting a recombinant DNA into said vector such that a recombinant protein is expressed when said vector is provided in an appropriate host wherein said DNA is selected from the group consisting of:
F 7 8 8	i) a recombinant DNA that encodes a protein having an amino acid sequence as shown in SEQ. ID. NO. 3;
H 9	ii) a recombinant DNA that encodes a protein having an amino acid sequence as shown in SEQ. ID. NO. 5;
11 12	iii) a recombinant DNA that encodes a protein having an amino acid sequence as shown in SEQ. ID. NO. 7;
13 14	iv) a recombinant DNA that encodes a protein having an amino acid sequence as shown in SEQ. ID. NO. 9;
15 16	v) a recombinant DNA that encodes a protein having an amino acid sequence as shown in SEQ. ID. NO. 11; and
17 18	vi) any portion of said DNA above that encodes a protein fragment that is greater than 25 amino acids.
1 2	27. The method of claim 26, wherein said DNA further comprises DNA that encodes CpG motifs.

	2	28. The method of claim 26 wherein said DNA further comprises a promoter selected from the group consisting of:
	3	a) a cytomegalovirus (CMV) immediate early promoter;
	4	b) a human tissue plasminogen activator gene (t-PA); and
	5	c) a promoter/enhancer region of a human elongation factor alpha (EF-1 $lpha$).
	1	29. The method of claim 26, wherein said vector is selected from the group consisting of:
	2	a) pcDNA3;
	3	b) pC1;
	4	c) VR1012; and
	5	d) VR1020.
	1	30. The method of claim 26 wherein said vaccine is injected into said host in a manner
-	2	selected from the group consisting of:
	3	a) intramuscular injection;
	4	b) intravenous injection; and
	5	c) gene gun injection.
	1	31. The method of claim 30, wherein said host is a dog.
	1	32. A method of creating a vaccine against E. canis comprising:
	2	a) selecting a vector capable of expressing a recombinant protein inserted
	3	into said vector;
	4	b) insertion of a recombinant DNA into said vector such that said
	5	recombinant protein is expressed when said vector is transformed
	6	into a bacterial strain wherein said DNA is selected from the group
	7	consisting of:

8	i) a recombinant DNA that encodes a protein having an amino acid
9	sequence as shown in SEQ. ID. NO. 3;
10	ii) a recombinant DNA that encodes a protein having an amino acid
11	sequence as shown in SEQ. ID. NO. 5;
12	iii) a recombinant DNA that encodes a protein having an amino acid
13	sequence as shown in SEQ. ID. NO. 7;
14	iv) a recombinant DNA that encodes a protein having an amino acid
15	sequence as shown in SEQ. ID. NO. 9;
☐ ☐ 16	v) a recombinant DNA that encodes a protein having an amino acid
<u>F</u> 17	sequence as shown in SEQ. ID. NO. 11; and
15 16 17 4 18	vi) any portion of said DNA above that encodes a protein that elicits
	an immune response against E. canis; and
19 20 1	c) harvesting said recombinant protein from said bacterial strain.
0 1	33. The method of claim 32, wherein said vaccine further comprises adjuvants selected
2	from the group consisting of:
3	a) aluminum hydroxide;
4	b) QuilA; and
5	c) Montamide.
1	34. The method of claim 32, wherein said vaccine further comprises a promoter selected
2	from the group consisting of:
3	a) tac;
4	b) T5; and
5	c) T7.

÷	1		35.	The method of claim 32, wherein said bacterial strain is E. coli.
	1	;	36.	The method of claim 32, wherein said vector is selected from the group consisting of:
	2			a) pREST;
	3			b) pET; and
TOTAL PARTY	4			c) pKK233-3.
	1 2	3	37.	The method of claim 32 wherein said vaccine further comprises a cytokine operatively associated with said vaccine.
	1 2	3	38.	The method of claim 37 wherein said cytokine is selected from the group consisting of:
	3			a) interleukin-1β (IL-1β);
	4			b) granulocyte-macrophage colony stimulating factor (GM-CSF);
	5			c) gamma interferon (γ-IFN);
print.	6			d) amino acids VQGEESNDK from the IL-I β protein; and
	7 8			e) any portion of any of the cytokines above that elicits an improved immunogenic response against <i>E. canis</i> .
	1 2	3	39. ʻ	The method of claim 32 wherein said vaccine is injected into said host in a manner selected from the group consisting of:
	3			a) intramuscular injection; and
	4			b) subcutaneous injection.
	1	4	0.	The method of claim 39 wherein said host is a dog.
	1	4	1.	A method of creating a T cell epitope vaccine comprising:

ے د	a) selecting a recombinant protein that includes a 1 cent epitope wherein
3	said T cell epitope comprises an amino acid peptide fragment of a
4	protein selected from the group consisting of:
5	i) a protein having an amino acid sequence as shown in SEQ. ID. NO.
6	3;
7	ii) a protein having an amino acid sequence as shown in SEQ. ID.
8	NO. 5;
9	iii) a protein having an amino acid sequence as shown in SEQ. ID.
⊨ 10 □	NO. 7;
Q 11	iv) a protein having an amino acid sequence as shown in SEQ. ID.
12	NO. 9;
13	v) a protein having an amino acid sequence as shown in SEQ. ID.
10 0 11 12 13 14 14 0 15 0 16	NO. 11; and
C) 15	vi) any portion of any of the above proteins that elicits an immune
☐ 16 →	response against E. canis;
17	b) identifying said T cell epitope from said protein;
18	c)incorporating said T cell epitope into a construct capable of expressing
19	said epitope as a protein; and
20	d)harvesting said protein.
1	42. The method of claim 41 wherein said amino acid peptide fragment comprises nine to
2	twenty amino acids.
1	43. The method of claim 41 wherein said construct capable of expressing said epitope
2	further comprises a recombinant DNA encoding a protein which is capable of
3	being internalized into eukaryotic cells, including cells of the immune system.

1	44. The method of claim 43 wherein said protein capable of being internalized into
2	eukaryotic cells comprises a toxin selected from the group consisting of:
3	a) a recombinant adenylate cyclase of Bordetella bronchiseptica; and
4	b) a recombinant exotoxin A (PE) of Pseudomonas aeruginosa.
1	45. The method of claim 41 wherein said vaccine is injected into said host in a manne
2	selected from the group consisting of:
3	a) intramuscular injection; and
는 4 디	b) subcutaneous injection.
디 다 도 도	46. The method of claim 45 wherein said host is a dog.
	47. A recombinant DNA comprising said DNA selected from the group consisting of
† 2	a) a recombinant DNA that encodes a protein having an amino acid
	sequence as shown in SEQ. ID. NO. 3;
1 4	b) a recombinant DNA that encodes a protein having an amino acid
5	sequence as shown in SEQ. ID. NO. 5;
6	c) a recombinant DNA that encodes a protein having an amino acid
7	sequence as shown in SEQ.ID. NO. 7;
8	d) a recombinant DNA that encodes a protein having an amino acid
9	sequence as shown in SEQ. ID. NO. 9; and
10	e) a recombinant DNA that encodes a protein having an amino acid
11	sequence as shown in SEQ. ID. NO. 11.
1	48. A vector capable of expressing a recombinant DNA comprising:
2	a) a recombinant DNA inserted into said vector such that a recombinant
3	protein is expressed when said vector is provided in an appropriate
4	host wherein said DNA is selected from the group consisting of:

, 3	i) a recombinant DNA sequence that encodes a protein having an
6	amino acid sequence as shown in SEQ. ID. NO. 3;
7	ii) a recombinant DNA sequence that encodes a protein having an
8	amino acid sequence as shown in SEQ. ID. NO. 5;
- 9	iii) a recombinant DNA sequence that encodes a protein having an
10	amino acid sequence as shown in SEQ. ID. NO. 7;
11	iv) a recombinant DNA sequence that encodes a protein having an
12	amino acid sequence as shown in SEQ. ID. NO. 9;
는 급13	v) a recombinant DNA that encodes a protein having an amino acid
14	sequence as shown in SEQ. ID. NO. 11; and
上 15	vi) any portion of said DNA above that encodes a protein that elicits
13 14 15 16	an immune response against E. canis.
1	49. The recombinant DNA of claim 47 wherein said DNA encodes at least one
C 2	immunogenic epitope.
	50. A vector capable of expressing a recombinant DNA comprising:
2	a)a recombinant DNA inserted into said vector such that a recombinant
3	protein is expressed when said vector is provided in an appropriate
4	host wherein said DNA is selected from the group consisting of:
5	i) a recombinant DNA that encodes a protein having an amino acid
6	sequence as shown in SEQ. ID. NO. 3;
7	ii) a recombinant DNA that encodes a protein having an amino acid
8	sequence as shown in SEQ. ID. NO. 5;
9	iii) a recombinant DNA that encodes a protein having an amino acid
10	sequence as shown in SEQ. ID. NO. 7;

11	iv) a recombinant DNA that encodes a protein having an amino acid
12	sequence as shown in SEQ. ID. NO. 9; and
13	v) a recombinant DNA that encodes a protein having an amino acid
14	sequence as shown in SEQ. ID. NO. 11.
15	
1	51. Serological diagnosis techniques using:
2	a) a recombinant DNA that encodes a protein having an amino acid
3	sequence as shown in SEQ. ID. NO. 3;
D 4	b) a recombinant DNA that encodes a protein having an amino acid
5	sequence as shown in SEQ. ID. NO. 5;
4 6	c) a recombinant DNA that encodes a protein having an amino acid
4 5 6 7 8 9	sequence as shown in SEQ. ID. NO. 7;
8	d) a recombinant DNA that encodes a protein having an amino acid
N 9	sequence as shown in SEQ. ID. NO. 9; and
10	e) a recombinant DNA that encodes a protein having an amino acid
11	sequence as shown in SEQ. ID. NO. 11.
1	52. The method of kinetic enzyme-linked immunosorbent assay comprising the
2	steps of:
3	a)selecting an antigen to be added to microtiter plates that includes an
4	immunogenic epitope comprising a recombinant protein selected
5	from the group consisting of:
6	i)a protein having an amino acid sequence as shown in SEQ. ID. NO.
7	3;
8	ii) a protein having an amino acid sequence as shown in SEQ. ID.
9	NO. 5;

10	iii) a protein having an amino acid sequence as shown in SEQ. ID.
11	NO. 7;
12	iv) a protein having an amino acid sequence as shown in SEQ. ID.
13	NO. 9;
14	v) a protein having an amino acid sequence as shown in SEQ. ID.
15	NO. 11;
16	vi) any portion of said DNA above that encodes a protein that elicits
17	an immune response against E. canis
⊬ □18	b) adding an antiserum of the species allowing it to complementarily bind
018 019 420 421	to the antigen;
	c) adding the antibody to the microtiter plate, allowing the antibody to bind
	to the antigen;
L 22 □ 10 10 23 □ 124	d) washing the microtiter plate to remove any unbound antibodies;
[U23	e) adding an enzyme the microtiter plates allowing the enzyme to bind to
<u>-</u> 24	the antibody;
25	f) washing the microtiter plate to remove any unbound enzyme; and
26	g) adding the enzyme's substrate, allowing it to bind to the enzyme, which
27	produces a color change when bound.
1	53. The method of claim 52, where said species is a canine.
1	54. The method of claim 52, wherein antiserum added to the microtiter plate is goat anti-
2	canine.
1	55. The method of claim 52, wherein the antibody added to the microtiter plate is second
2	antibodies of a goat anti-canine antibody of heavy and light chain specificity.
1	56. The method of claim 52, wherein the enzyme added to the microtiter plate is
2	horseradish peroxidase.

1	57. The method of claim 52, wherein the enzyme's substrate is chromogen
2	tetramethylbenzidine with H ₂ O ₂ .
1	58. The method of western blot analysis comprising the steps of:
2	a) obtaining the species serum with antigens, where said antigen includes
3	an immunogenic epitope comprising a recombinant protein selected
4	from the group consisting of:;
5	i)a protein having an amino acid sequence as shown in SEQ. ID. NO. 3;
7 7 8 5 9 7 10	ii) a protein having an amino acid sequence as shown in SEQ. ID. NO. 5;
2	iii) a protein having an amino acid sequence as shown in SEQ. ID.NO. 7;
11 12 12 0 13	iv) a protein having an amino acid sequence as shown in SEQ. ID. NO. 9;
₩ ₩13	v) a protein having an amino acid sequence as shown in SEQ. ID.
14	NO. 11;
15	vi) any portion of said DNA above that encodes a protein that elicits
16	an immune response against E. canis
17	b) running the serum through sodium dodecyl sulfate-polyacrylamide gel
18	electrophoresis, allowing proteins to be fractionated into a series of
19	bands arranged in order of molecular weight;
20	c) transferring the proteins to a filter by blotting;
21	d) adding antibodies tagged with a dye are washed over the filter, allowing
22	the antibodies to bind to the fractionated proteins; and
23	e) adding substrates to develop the bands on the filter.

•	1	59. The method of claim 58, wherein said species is a canine.
	1	60. The method of claim 58, wherein the antibodies are goat anti-dog igG conjugated to
	2	horseradish peroxidase.
	1	61. The method of claim 58, wherein the substrates added to develop the bands on the
	2	filter are:
	3	a) 4 chloro-1-napthol in methyl alcohol;
	4	b) tris-buffer solution with a pH of 7.5; and
	5	c) $30\% \text{ H}_2\text{O}_2$.
	1	62. The method of polymerase chain reaction comprising the steps of:
	2	a) selecting a target strand of DNA that will serve as a template for DNA
= इ	3	synthesis comprising recombinant DNA selected from the group
	4	consisting of:
	5	i) a recombinant DNA that encodes a protein having an amino acid
ļ.	6	sequence as shown in SEQ. ID. NO. 3;
	7	ii) a recombinant DNA that encodes a protein having an amino acid
	8	sequence as shown in SEQ. ID. NO. 5;
	9	iii) a recombinant DNA that encodes a protein having an amino acid
	10	sequence as shown in SEQ. ID. NO. 7;
	11	iv) a recombinant DNA that encodes a protein having an amino acid
	12	sequence as shown in SEQ. ID. NO. 9;
	13	v) a recombinant DNA that encodes a protein having an amino acid
	14	sequence as shown in SEQ. ID. NO. 11; and
	15	vi) any portion of said DNA above that encodes a protein that elicits
	16	an immune response against E. canis;

•	17 18	b)adding a mixture containing enzymes, nucleotides, DNA polymerase, and primers;
	19 20	c)subjecting above mixture to a number of cycles of amplification in an automated DNA cycler; and
	21 22	d)using products of said cycles of amplification and performing gel electrophoresis.
	1	63. The method of claim 62, wherein the mixture is comprised of:
FOOT	2	a) 50 mM KCl;
	3	b) 10mM Tris-HCl with a pH of 8.3;
F	4	c) 1.5 mM MgCl2;
	5	d) 0.5% NP40;
	6	e) 0.5% Tween 20;
	7	f) 200 mM each of deoxynucleoside triphosphates;
	8	g) 2 mM of primer sets; and
	9	h) 2 U of thermostable Taq DNA polymerase.
	1	64. The method of claim 62, wherein the said number of cycles of amplification is 40.
	1	65. The method of claim 62, wherein the said cycles of amplification are comprised of
	2	a) heating to 94°C for 1 minute to allow the DNA to denature;
	3	b) cooling to 69°C for 1 minute to allow the primers to anneal; and
	4	c) heating to 72°C for 2 minutes to allow for primer extension.